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SWOT Analysis in Engineering Classes using Audience Response System

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***Abstract*— Feedback is central to the development of student learning. The purpose of feedback is to address the learning gaps at the earliest possible stage of learning cycle. This paper presents the use of instant feedback in classes with the help of Audience Response System (ARS) in teaching of a First Year Engineering subject. The ARS is used to pose a few questions intermittently during a lecture on students' mobile phone. The students' responses are used to identify the Strengths, Weaknesses, Opportunities and Threats (SWOT) based on correctness and confidence levels. SWOT analysis of every individual student allows a teacher to provide personalized coaching on the basis of the topics identified as areas of opportunity, threat and weakness. The performance of the entire class is also monitored at regular intervals.**

***Keywords*—Audience Response System; Continuous and Comprehensive Assessment; Instruction; Learning Outcomes; Teaching-Learning.**

***JEET Category*—Research**

I. INTRODUCTION

RECENT developments in Social Science research have presented a lot of evidences about how humans think and learn. The three fundamental Social Science generalizations in teaching – learning,

1) Social connections motivate

2) Teaching teaches the teacher

3) Instant feedback improves learning,

have been applied and studied extensively for improvement of teaching and learning.

Nowadays, newer technologies like radio, television, smart boards, power point slides etc. are rigorously employed for teaching learning. A few group activities where lots of discussion is involved, are also being implemented. However the typical arrangement of majority of the classrooms in Universities is still with all students facing the black board/LCD screen and students still trying to create an impression that they are attentive while the teacher continues to teach for almost an hour or so. Many generations have passed without any major breakthrough in procedures and styles of teaching in our classroom in spite of emphatic need for more research in education. The focus of the presented work, is to apply Social Science knowledge and technological interventions to help the teachers to teach better. Although no technology used by itself had any necessary effect on learning and new teaching technology can often be a distraction, some new technologies like the Audience Response System (ARS) make it easier to take advantage of the Social Science insights to improve teaching.

Several studies reported in literature have investigated and analyzed interconnected themes such as student engagement (Mathiasen, 2015; Hoekstra, 2014), interaction in classes (Heaslip et al., 2014; Ismaile & Alhosban, 2018), effect of anonymity on participation (Patterson et al., 2010; Brady et al., 2013), different types of questioning, instant feedback (Florenthal, 2019; Bhamre & Jagtap 2021), impact on learning outcomes (Sheng et al., 2019; Egelandsdal & Krumsvik, 2017; Bhamre et al., 2021) and technological limitations and benefits (Grund & Tulis, 2019). Pianta, 2016, reported that interactions must be frequent, consistent and also meet certain quality threshold to manifest the positive effects in student outcomes.

The proposed study aimed at applying the Social Science generalization of instant feedback in classes with the help of ARS in teaching of a first year subject of a degree program of Engineering. The main objectives of the study were -

1) To identify topic wise strengths, weaknesses, opportunities and threats for an individual student in the selected first year engineering course.

2) To capture students' confidence level and correctness while answering questions in lectures with the help of an instructional support system.

II. METHODOLOGY

The participants of this study were 68 first year engineering students of Information Technology program, who gave consent to participate in this study. 140 Challenging multiple choice questions on six topics of Basics of Electronics Engineering were framed as per the teaching plan of the course. Questions related to the content taught by the teacher, were posed intermittently during a lecture on students' mobile using the MKCL LearniCo tool. The software application collected/segregated the students'

responses and a real time statistics was provided to the teacher after each question. This summary of responses in classrooms enabled the teacher to provide a meaningful & immediate feedback to students. Fig.1 shows the summary of responses collected for a sample question posed in the class and Fig. 2 shows the screenshots of the student's mobile application.

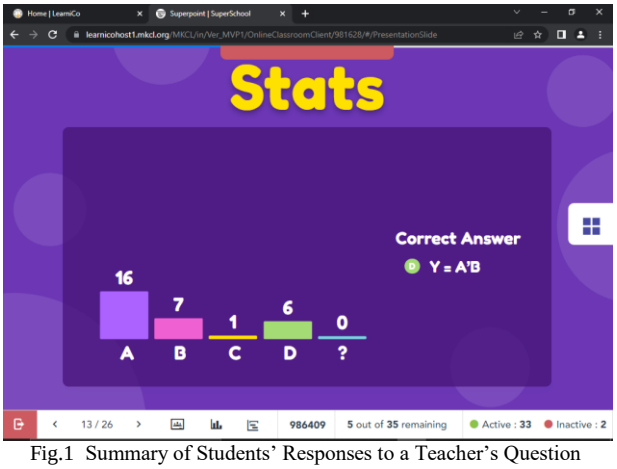

Fig.1 Summary of Students' Responses to a Teacher's Question

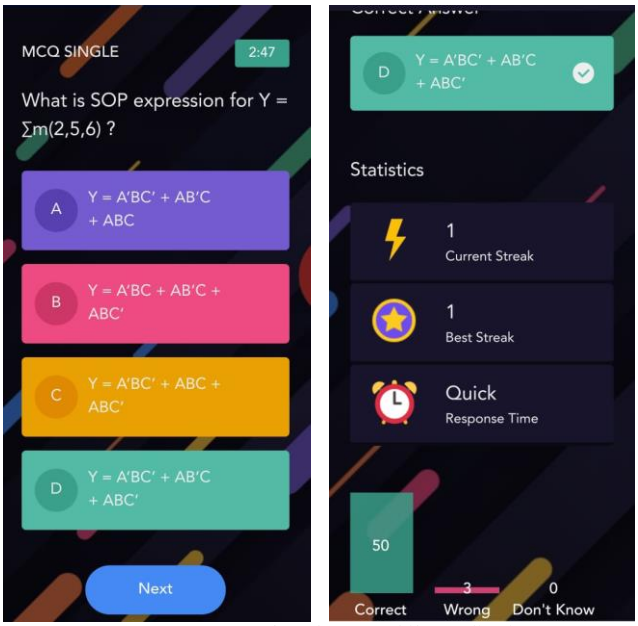

Fig.2 Screenshots of Student's Mobile Application

Apart from capturing the choice of answer for the questions asked, the students were also asked to rate their confidence level on a scale of 5 while answering every question that was asked by the teacher. Based on the correctness of the answer and the confidence level indicated by the students, the performance of every student was classified into four categories after each lecture –

1) High Correctness and High Confidence
2) High Correctness and Low Confidence
3) Low Correctness and High Confidence
4) Low Correctness and Low Confidence

In order to analyse the topic wise strengths, weaknesses, opportunities and threats for an individual student, the thresholds for correctness and confidence levels were selected as in Table I.

TABLE I
THRESHOLD LEVELS FOR SWOT ANALYSIS

Category	Threshold Levels	
	Correctness	Confidence
High Correctness and High Confidence	50-100%	2.5 to 5
High Correctness and Low Confidence	50-100%	0 to 2.5
Low Correctness and High Confidence	0 to 50%	2.5 to 5
Low Correctness and Low Confidence	0 to 50%	0 to 2.5

When a student responds with high correctness and high confidence for questions of a particular topic, that topic is identified as the strength of the student. In case the correctness level is high but the student responds with less confidence for a certain topic, then the topic is categorised as an opportunity for the student, since he/she can easily improve on it. When the correctness level for a certain topic is low, but confidence level is high, then the topic under this category is treated as a threat and the student needs to pay more attention to such a topic. Finally questions of any topics answered with low correctness and low confidence are treated as weaknesses and could result in failure and therefore such topic should be addressed with proper attention by the teacher and the student.

III. RESULTS AND DISCUSSION

MKCL LearniCo tool was used in 30 (out of 36) lectures conducted for the course on Basics of Electronics Engg, to pose a total of 138 multiple choice questions. An average of 50 out of 68 students, were present for these 30 lectures.

A. Average Class Performance

Fig.3 shows the average correctness percentage of the entire class for all 30 lectures. The minimum average correctness percentage of class was 34% whereas the maximum average correctness percentage was 88%. The average class correctness percentage of all 30 lectures was 68%.

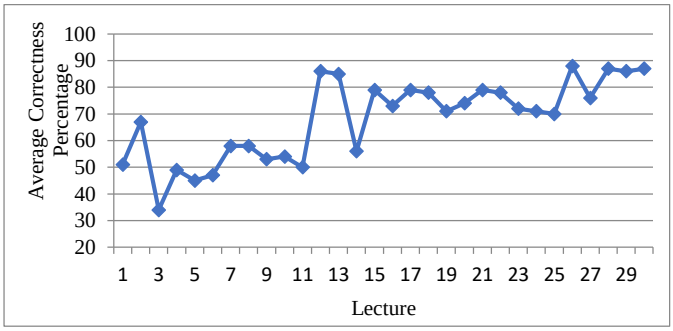

Fig.3 Average correctness percentage for 30 lectures

B. Tracking of Performance of Lagging Students

Based on the correctness levels and confidence levels exhibited by students in the first 15 sessions, 9 students were identified with either lowest correctness percentage or lowest confidence level or those who had attended least number of lectures. Individual mentoring for understanding difficulties

related to the topics covered in the first 15 sessions were conducted and the performance was tracked in the following sessions. Comparative performance of these nine students at the end of first and second month is shown in Table II.

Fig.4 shows the correctness of Student 1 from Table II in comparison with the average correctness of the class. Fig. 4 shows a pentagonal radar plot with five points for the five units of the subject indicating average correctness of the class for and correctness of the student. It can be noted that although the performance of the Student 1 was significantly less for the first unit on Introduction to Electronics, her performance has improved and is at par with the class performance in the later units. Similarly Fig.5 and Fig.6 show similar comparisons of correctness of Student 5 and Student 8 from Table II with the average correctness of the class.

TABLE II
PERFORMANCE OF LAGGING STUDENTS
(A - No. of sessions attended, B – Percentage of Correctness, C – Confidence Percentage)

Sr.No.	First Month Performance			Second Month Performance		
	A	B	C	A	B	C
Student 1	12	41.82	60	19	58.12	60
Student 2	15	48.57	60	21	58.7	60.22
Student 3	6	77.42	63.87	16	82.43	61.62
Student 4	3	70	60	14	86.21	59.66
Student 5	14	49.02	60	21	64.29	60
Student 6	14	47.27	54.18	18	52.74	58.9
Student 7	6	51.85	60.74	14	66	60.4
Student 8	13	47.92	60	22	61.59	60.49
Student 9	5	60.87	81.74	13	63.73	70.59

C. SWOT Analysis

Based on the correctness levels and confidence levels, topic wise strengths, weaknesses, opportunities and threats for an individual student can be identified. Table III lists the top nine students who had attended highest number of lectures along with the number of topics identified as strengths, weaknesses, opportunities and threats. Similar analysis was carried out for every student in the class.

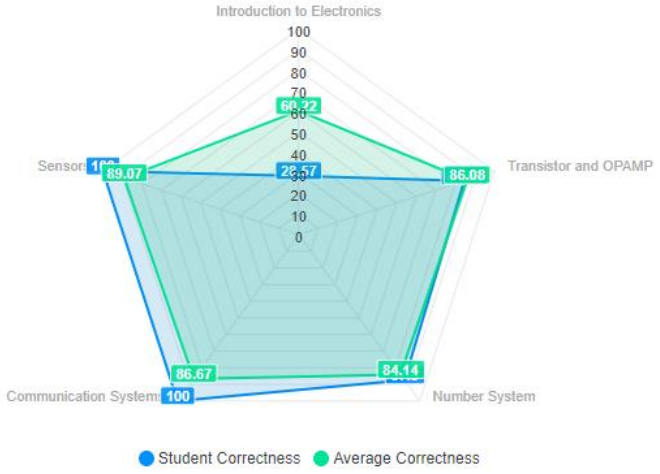

Fig.4 Comparison of correctness of Student 1 (Table II) with average correctness of class

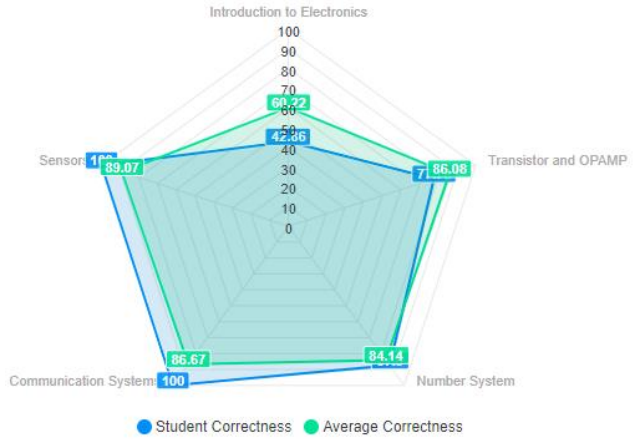

Fig.5 Comparison of correctness of Student 5 (Table II) with average correctness of class

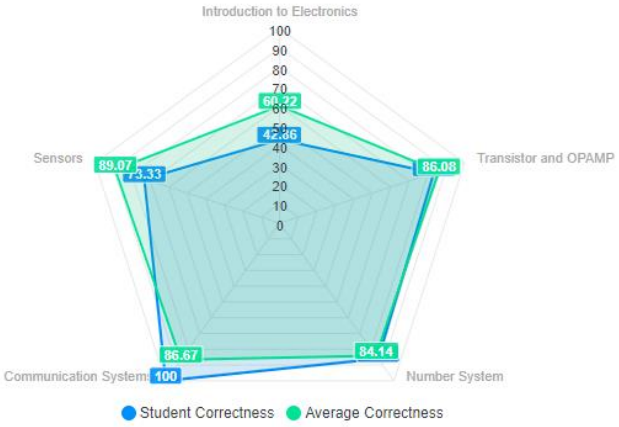

Fig.6 Comparison of correctness of Student 8 (Table II) with average correctness of class

TABLE III
PERFORMANCE OF LAGGING STUDENTS
(A - No. of sessions attended, B – Percentage of Correctness, C – Confidence Percentage, S – Strengths, W – Weaknesses, O – Opportunities, T - Threats)

Sr.No.	A	B	C	S	W	O	T
Student 10	30	75.95	58.93	17	3	7	3
Student 11	29	86.26	62.6	17	2	7	3
Student 12	29	70.7	62.03	17	2	7	3
Student 13	28	91.6	64.89	10	3	11	4
Student 14	28	81.06	63.64	10	3	11	4
Student 15	28	80.62	79.07	10	3	11	4
Student 16	28	75.44	83.33	10	4	10	4
Student 17	28	72.76	64.72	10	4	10	4
Student 18	28	64.39	58.79	10	4	9	5

The confidence and correctness levels of all students in the form of a scatter plot are depicted in Fig.7 to Fig.9. Fig.7 shows the scatter plot after first two weeks of conduction of

the course. Fig. 8 shows the scatter plot after completion of six weeks whereas Fig.9 shows the scatter plot after completion of the full course i.e. after twelve weeks of conduction. Comparison of scatter plots of Fig.7 to Fig.9 shows the gradual improvement of confidence and correctness levels of the students as the course progressed.

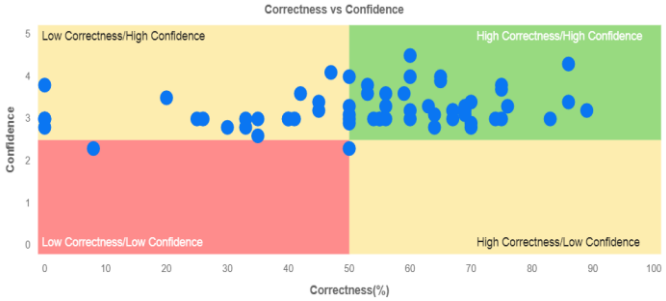

Fig.7 Confidence and correctness levels of all students at the end of first Two weeks of conduction of the course.

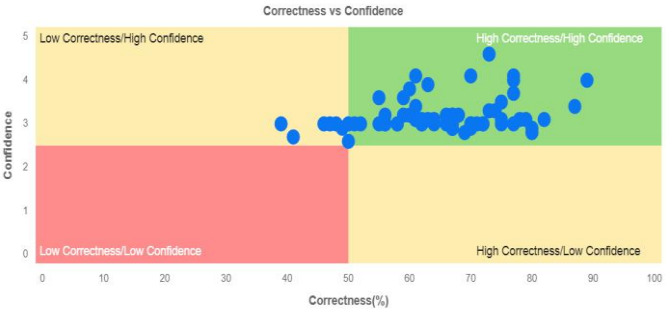

Fig.8 Confidence and correctness levels of all students at the end of Six weeks of conduction of the course.

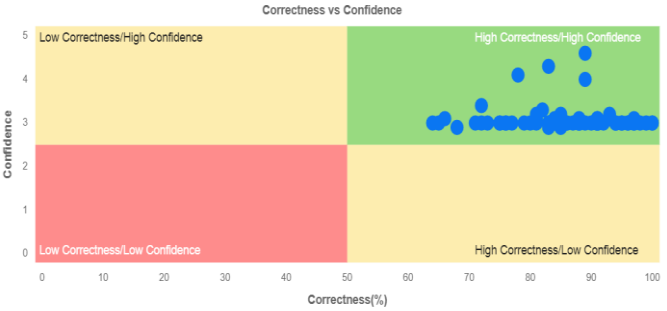

Fig.9 Confidence and correctness levels of all students at the end of Twelve weeks of conduction of the course.

D. Survey Analysis

An end semester survey was also conducted to find the extent to which the feedback intervention approach had helped the students. A total of 65 students participated in this survey. Fig.10 shows the students' responses for various personal aspects of participation in the class with the help of Audience Response System.

IV. CONCLUSION

A simple and systematic feedback intervention using an Audience Response System was successfully implemented in the conduction of a First Year Engineering course. The feedback intervention not only helped in improving engagement and participation of students, but also effectively classified the topics of the course as strengths, weaknesses, opportunities and threats for each student individually, based on correctness and confidence levels. Such SWOT analysis, therefore has easily identified the slow learners in the class and topic wise remedial coaching could then be offered to such students. The purposeful feedback intervention in classes

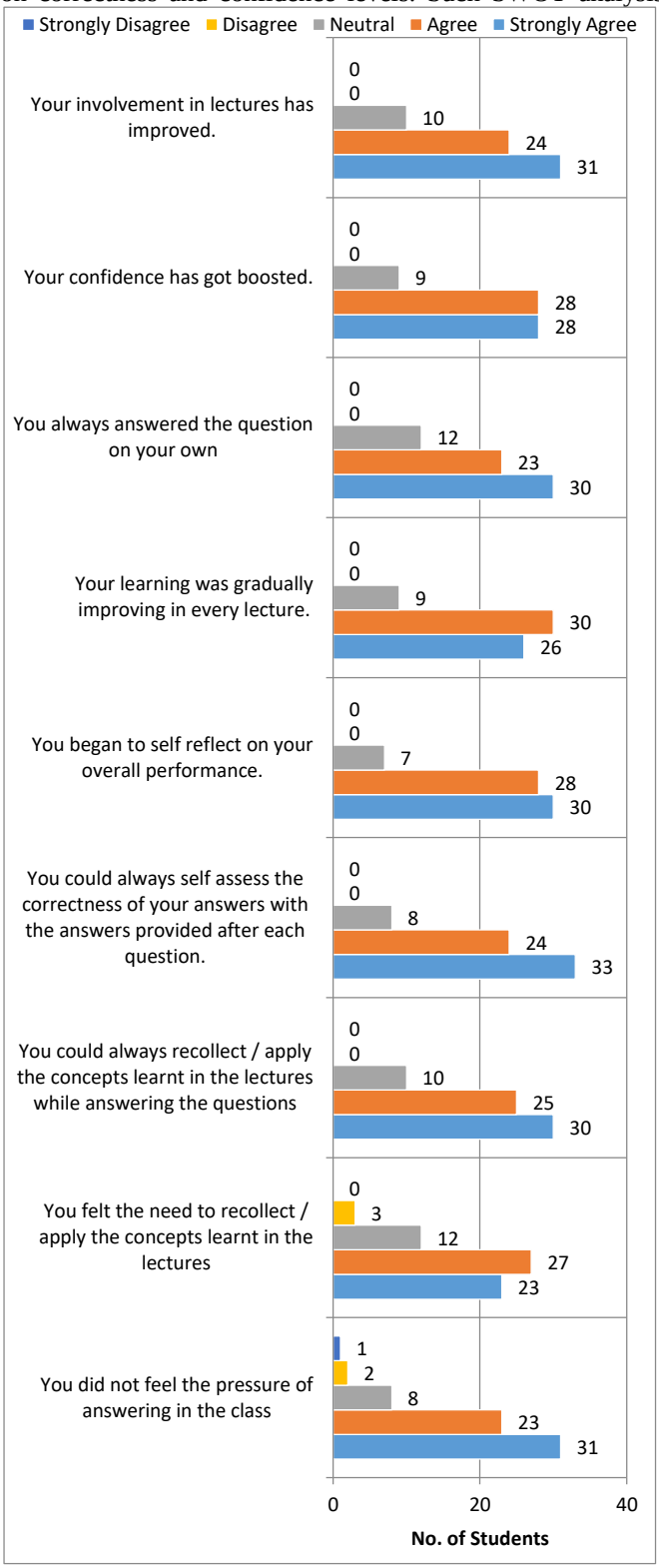

Fig.10 Statistics of End Semester Survey Analysis

thus greatly helped in improving the performance of the students in classes. Such an intervention can also be used for all Engineering courses not only for SWOT analysis but also for rigorous continuous and comprehensive assessment.

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